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ABSTRACT

The first purpose of the study reported in this paper was to determine whether subjects trained in phonemic segmentation and spelling would have an advantage in segmenting, which would establish a causal relationship between segmenting and reading. The second purpose was to see whether trained subjects were better blenders than control subjects. Subjects were 22 middle-class first-grade students at a New York City independent school. The students were assigned to two treatment groups using stratified random assignment with strata based on kindergarten teachers' predictions of reading success. The Test of Auditory Analysis Skills, the Block Segmentation Test, and the Roswell-Chall Blending Test were administered for pre- and posttest measures. First graders were trained for 6.5 months to segment and spell with wooden blocks and to spell on the computer. Control subjects were trained to read letters and blend words, and to read text on the computer. Results indicated that trained subjects were significantly better than controls by posttest on measures of segmentation and blending, even though blending was not taught explicitly to experimental subjects. Results suggest that blending is associated with skilled reading and is facilitated by segmentation training. (Three tables of data are included and 30 references are attached. One appendix contains the Block Segmentation Test.) (Author/MG)

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The Effects of Segmentation and Spelling Training on the Blending Skills of Beginning Readers

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Running Head: Effects of Segmentation on Blending

Abstract

Phonemic segmentation and blending skills are believed to reflect the development of phonemic awareness in beginning readers, but the relationship between these two skills is unclear. This study is a further analysis of earlier work suggesting that segmentation and spelling training have a positive effect on beginning reading skills (Uhry & Shepherd, 1990), and was designed to explore the effect of segmentation/spelling training on blending skills. First graders were trained for six and a half months to segment and spell with wooden blocks and to spell on the computer. Controls were trained to read letters and blend words, and to read text on the computer. Trained subjects were significantly better than controls by posttest on measures of segmentation and blending, even though blending was not taught explicitly to experimental subjects. Results suggest that blending is associated with skilled reading and is facilitated by segmentation training.

The Effects of Segmentation and Spelling Training on the Blending Skills of Beginning Readers

In order to read phonetically, rather than to read by memorizing a finite number of words from books, young readers need to be able to understand and make use of the complex relationship between sounds in spoken language and letters in printed words. That is, they need some level of phonemic awareness or sense of sound patterns in speech. In addition they need skills in associating sounds with letters and in combining these sounds until a spoken word can be recognized.

An earlier study (Uhry & Shepherd, 1990) suggested that training in phonological skills, effected through six and a half months of segmentation and spelling training as a supplement to whole language reading instruction, resulted in better reading for first grade subjects than for controls. While these results are consistent with findings from a large body of research on segmentation training, neither the reading data from our study nor that from the existing literature is able to clarify the relationship between segmenting and reading in a specific way. We know that children's sense of the sound structure of words is enhanced by segmentation training, but does this mean that they are better able to blend when they read?

In our earlier study (Uhry & Shepherd, 1990), our trained first graders were better than controls at oral passage reading and word list reading, but the most dramatic difference was on nonsense word reading. The reading of consonant-vowel-consonant (cvc) nonsense words is often used to test for a letter-by-letter, left-to-right sounding out and blending strategy. However, our subjects were also better at reading nonsense words with more complex units where letter sounds were conditional on the patterns of surrounding letters

(e.g., raved, eam, pertome). It is possible that the cvc blending strategy prepared experimental subjects for a careful, left-to-right reading of these unit words (Frith, 1985). On the other hand, it is also possible that cvc words, as well as unit words, were read by analogy to known words. Goswami's (1986) findings that very young children can read by analogy suggests this as a possibility. In other words, does segmenting teach children to read by blending or does it simply increase phonological awareness to the point where they understand the sound structure of words well enough to read by analogy to other words?

A good deal of literature exists to suggest clear patterns in regard to segmentation skills. Children as young as three are sensitive to the rhyming segments of words (Maclean, Bryant & Bradley, 1987). By three or four they can segment words from sentences (Fox and Routh, 1975). Preschool children are able to segment syllables from words, and later, at about the time reading is taught, phonemes from words (Liberman, Shankweiler, Fischer, & Carter, 1974). Deletion tasks follow this same pattern. Rosner & Simon (1971) found that kindergarten children could delete syllables from words, and first graders could delete phonemes. They found that initial and final consonants were easier to delete than consonants embedded in blends. Spelling for young children involves segmentation and then representation with sound-alike letters. This also follows a pattern, with early representation of initial consonants, and with blends coming later (Morris & Perney, 1984). Stanovich, Cunningham, & Cramer (1984) examined a number of segmenting and deleting tasks, and found them to be almost interchangeable as valid predictors of later reading. In other words, all tapped the same construct. All of the above tasks have been used to predict later reading ability. In addition,

segmentation and/or spelling training have been used to teach reading (e.g., Ball & Blachman, 1988; Bradley & Bryant, 1983; Ehri & Wilce, 1987). See Goswami and Bryant (1990) for a more detailed overview of the literature on phonological skills.

Blending is also considered a source of information regarding the development of phonological awareness. There is evidence in the literature, parallel to that on segmentation, suggesting that blending develops over time and is associated with successful reading (Chall, Roswell, & Blumenthal, 1963). However, as Lewkowicz (1980) points out, there is little literature to suggest that blending can be taught successfully. Williams (1980) used blend training as part of a method called the ABD's of Reading. Older, reading impaired inner city youngsters were trained to analyze (segment), blend, and decode. Results were positive but did not clarify the particular role of blending. In a recent experiment, Weisberg, Andracchio, and Savard (1989) report improvements in kindergarten in both blending and reading through use of the SRA Reading Mastery program where the teacher stretches out sounds in words and then encourages children to blend by saying the sounds rapidly. However, the direction of the relationship between blending and reading was not clarified and segmenting was not used.

The connections between blending and segmenting are unclear. Blending and segmenting training have been explored in several studies designed by Fox and Routh. In their 1976 study, four year old children who began as better segmenters were more responsive to blend training, suggesting that segmenting precedes and readies young children for blending. Later, in discussing a second study (1984), they point out that initial blend measures were not taken in 1976, and that the better segmenters may have been better blenders as well,

which confuses the issue. In the 1984 study, kindergarten poor segmenters who were taught to blend as well as segment scored higher on these tasks, as well as on a reading analog task, outperforming poor segmenting controls with no training or with segmenting training alone. Fox and Routh interpret results to suggest that phonological training facilitates reading but that the relationship between blending and segmenting is still unclear.

Perfetti, Beck, Bell, and Hughes (1987), in a longitudinal study of first grade children, used partial time-lag correlations to suggest that blending is a simple precursor to reading while segmenting is a more complex, higher level, metacognitive linguistic skill which both enables reading and benefits from it over time. Yopp (1988) used factor analysis to suggest that segmenting and blending tap similar constructs, and she agrees with Perfetti in suggesting that blending is easier than segmenting.

Advocates of invented spelling suggest the opposite. For example, Graves and Stuart (1985) suggest that segmenting the spoken word, which is familiar, is easier, and thus spelling is a good precursor to the more abstract task of blending units of sound in reading.

While the first grade children in the present study were too old and too skilled in both blending and segmenting at the onset of training to settle issues of which phonological skill comes first, there are several issues which can be clarified through analysis of additional data. The first involves establishing a causal role for segmenting. We know that training in segmenting was associated with an advantage in reading. In order to establish a causal role, we need to see if there was also an advantage in segmenting by the end of the study.

The second issue involves strategy use. Was this advantage in reading associated with an advantage in blending? Anecdotal evidence from Ehri and Wilce (1987) suggests that their younger trained readers were not blending but remembering a few salient features of words. Note that this is not what Goswami refers to when she talks about using rimes, or the rhyming parts of words, to read by analogy. On the other hand, while there is little in the literature documenting the effect of segmentation on blending, it is logical to suppose that segmenting may facilitate reading by encouraging a left-to-right, letter-by-letter strategy in which single sounds are blended.

It was the purpose here to determine whether trained subjects would have an advantage in segmenting, which would establish a causal relationship between segmenting and reading. The second purpose was to see if trained subjects were better blenders than controls.

Method

Subjects

Twenty-two middle class first grade students at a New York City independent school were assigned to two treatment groups using stratified random assignment with strata based on kindergarten teachers' predictions of reading success. There were six girls and five boys in each group, and distribution was even across the two first grade classrooms to control for teacher effects. Prior to training there were no group differences in 1985 Slosson Intelligence Test scores (M = 123.2), nor in age (M = 6-6), nor on several pretest measures of reading. See Table 1 for pretest scores.

Insert Table 1 about here.

In early October, before treatment began, both groups were virtually nonreaders. Passage scores from the Gray Oral Reading Test (GORT) converted to a grade equivalent of approximately 1.2 for both groups. Subjects were not able to read this preprimer level text fluently. They knew only a few of the sight words. They could decode only a few nonsense words on the Word Attack subtest of the Woodcock Reading Mastery Tests. They were able to blend adequately on the Roswell-Chall Blending Test in terms of combining two and three sounds into words. They could delete syllables from compound words and some initial consonants from words on the Test of Auditory Analysis Skills (Rosner).

Pretest-Posttest Measures

The Test of Auditory Analysis Skills (Rosner), was administered at pre- and posttest in October and late April. Subjects were asked to delete syllables and then phonemes from words. The 13 items range from deletion of shine in sunshine to deletion of consonants in consonant blends. A second segmentation measure, the Block Segmentation Test was developed by the author at the suggestion of Linnea Ehri and was based on one used by her with kindergarten children (Ehri & Wilce, 1987). It consists of 25 progressively longer short vowel words and nonsense words. (See the Appendix.) Subjects were asked to say each phoneme in a word while sliding a block into place from left to right. This was administered at posttest only.

The Roswell-Chall Blending Test was administered at pre- and posttest. It consists of 30 one syllable words presented orally by the examiner in either two or three segments, and then blended into words by the subject. Because so many subjects in both groups came so close to ceiling, the Sound Blending subtest of the Illinois Test of Psycholinguistic Abilities was also administered at posttest. The 32 items on the ITPA begin with short words divided into two segments and progress to long words and nonsense words (e.g., telephone, opasto).

Treatment

Classroom Instruction. Treatment supplemented an eclectic classroom program involving a short oral phonics lesson in letter-sound associations each Monday based on a sequence presented in Recipe for Reading (Traub & Bloom, 1975). Both teachers, however, professed more confidence in the "whole language" approach and programmatic emphasis was on trade books with shared readings, as well as on writing using invented spellings.

Experimental Treatment: Segmentation/Spelling. Both groups received instruction in groups of five to six children for 20 minutes twice a week. Instruction for experimental subjects involved using one inch wooden blocks and then computers for segmenting and spelling using the same sequence of letter-sound associations from Recipe for Reading introduced in the classroom each week. Subjects listened to a word, echoed it, said each phoneme aloud while representing it with a block, and then said the word aloud again. This last step was added to training on a consistent basis because so many children spontaneously repeated the word as they picked up the blocks again to prepare for the next word. About eight words were segmented by the group in unison. Next each subject took a turn segmenting a word individually. All children

were given immediate feedback and extra practice to mastery as necessary. Eventually labels were used to put a letter on each of the six sides of three blocks. Labels were changed weekly to accomodate new words. During the second portion of each 20 minute session children spelled these same words on a word processing program. This programmed computer spelling games which were then played. A schedule of both experimental and control treatments appears in Table 2, with a more detailed version available from the author.

Insert Table 2 about here.

Control Treatment: Reading Letters, Words, and Text. Controls were also trained for 20 minutes twice a week in groups or five or six. This training also consisted of a sequence of letter sounds from Recipe from Reading, combined into the same eight cvc words each week, and later, into more complex words. Subjects began each session by reading these words aloud, both as a group and then as individuals, with direct instruction in blending the sounds through teacher modeling in cases where children could not do this themselves. After this direct instruction, controls read these same words on the computer and then played computer games involving reading (e.g., matching words with pictures) but not spelling. They also read stories aloud from the computer.

Results

Means and standard deviations for the two groups are presented in Table 3. Pretest-posttest analysis of variance (ANOVA) and covariance (ANCOVA) were used for data analysis.

Insert Table 3 about here.

Segmenting Measures

At pretest, in early October, group differences were not found on the Test of Auditory Awareness Skills (Rosner). The mean for each of the groups lay between 4 and 5 items. Items on the Rosner are arranged in order of difficulty and testing ends with 2 missed items so the score provides a sense of qualitative as well as quantitative ability. Initially both groups were able to delete syllables from words (items 1-3) and to delete at least one consonant at the beginning of a word. By the end of the study, there was a significant group difference, F (1, 20) = 9.12, $p < .01$. Trained subjects had the advantage. With a mean score of 11.5, they were able to delete at least one or two consonants from consonant blends. Controls, with a mean score of 8.4, could delete initial and final consonants but not when they were embedded in blends. Differences were qualitative, then, as well as quantitive.

The Block Segmentation Test was also used at posttest in order to be sure that this difference existed on a task which was a closer approximation of the training task. Assumptions of ANCOVA were not met, but equivalence at pretest could be assumed from Rosner scores. Remember that Stanovich, Cunningham, and Cramer (1984) found these tasks to be virtually interchangeable as valid measures of phoneme analysis ability. Using one way ANOVA, the trained group was found to be significantly better than controls at segmenting these real and nonsense words, F (1, 20) = 7.23, $p < .05$. In other words, after training,

experimental subjects were superior to controls on both of these phoneme analysis measures.

Results suggest that training was effective and that gains in reading can be causally related to segmentation/spelling training which produced significant differences in segmentation tasks.

Blending Measures

As with segmenting measures, group differences in blending were not found at pretest. Control scores were slightly, but not significantly higher, and both groups were blending at levels higher than Roswell-Chall criteria for "adequate" first grade blending. They could blend two and sometimes three sounds together into recognizable words. At posttest, trained subjects were significantly higher than controls, F (1, 20) = 6.44, $p < .05$. While significant, this difference was small as both groups were almost at ceiling, so that there are no qualitative differences or real practical applications for this finding.

The more complex items of the ITPA were also administered at posttest. Assumptions of ANCOVA were met using Roswell-Chall scores at pretest as the covariate and posttest ITPA scores as dependent variable. Again, the trained subjects outperformed controls, F (1, 20) = 40.72, $p < .0001$. A qualitative difference is also suggested here, with a higher score involving superior skill with longer real and nonsense words. Here trained subjects could blend long words and words for which they had no prior spoken model.

In addition to a superiority in segmenting, then, there was also a superiority in blending on two measures.

Discussion

The issue to be clarified here is whether segmentation/spelling training had facilitated reading in our earlier study (Uhry & Shepherd, 1990) by increasing phonological awareness in a rather global manner, or in contrast, by increasing blending ability. Results here suggest that both segmentation and deletion skills were positively affected by training. Thus a causal relationship between segmentation and reading is suggested.

Blending skills were also positively affected. There were significant but small differences in blending short words and more dramatic differences in blending words with more segments. Our main finding, then, is that despite evidence of analogy reading on more complex words in the 1990 study, analysis of additional data here suggests that trained subjects were capable of using strategies involving what turned out to be superior blending skills.

Results here are consistent with the Fox and Routh studies (1976, 1984) in that there seems to be a close and complex relationship between segmenting and blending. In neither of their studies, nor here, is there any evidence that children can be either weak or strong in just one of these phonological skills without also being weak or strong in the other. This is consistent with Yopp's (1988) suggestion that blending and segmenting are significantly and positively correlated.

This raises additional issues. Why did segmentation training increase reading and blending skills to a greater degree in experimental subjects than in controls where blending was actually taught? If segmenting training increased blending ability, why didn't blending training increase segmenting ability?

I suspect that the answer to this lies in the nature of the training tasks themselves. The past 30 years have yielded rich examples of segmentation training techniques. Note that in all of the following, children are asked to use concrete markers for segmenting. Elkonin (1963, 1973) asked children to look at a picture of an object, to say the word aloud, and to segment the word into phonemes while pushing tiles into a series of boxes beneath the picture. Later these tiles were lettered so that the segmenting task became a spelling task. Ball and Blachman (1988) modified Elkonin's techniques in a number of inventive ways with kindergarten children. Classification tasks were developed by Bradley and Bryant (1983) for four and five year olds with pictures of objects sorted using rhyme and alliteration. When children segment during invented spelling, they are actively involved in writing or choosing letters to stand for sounds. Hohn and Ehri (1983) found that lettered tokens were more effective than plain tokens in teaching segmentation. Later, Ehri and Wilce (1987) used lettered tiles in teaching children to read by teaching them to spell.

By contrast, blending is rarely taught using any kind of game or manipulative material. While print is present, it is not manipulated. As in the present study, children usually listen to a teacher either directing them to say the sounds faster or modeling it. Blend training is often manipulated by controlling the unit sizes and positions in words. This was done in Williams (1980) study to provide a sequence from easier to more difficult segmenting. That is, cv-c breaks were taught first, then c-vc, and finally, c-v-c. The relative ease in reading units in some positions over others is an important principle in Goswami's (1986) work on analogies. However, there have

been few attempts to design blending tasks other than by controlling unit size. Manipulative materials are not usually employed in blending tasks.

The segmenting training in the present study may actually provide such a task. Remember that children were asked to repeat the word, and then to say each sound while representing it with a block and then to say the word again as they picked up the blocks. The segmentation task modeled blending as well as segmenting. The blocks were first spaced apart as phonemes were said aloud, then pushed together as the word was repeated. In response to Fox and Routh's (1976) findings that segmentation skill helped the development of blending, Lewkowicz (1990) comments that taking apart may clarify putting together, just as with alarm clocks. The use of blocks to take words apart, and subsequently, to put them back together may be the key factor here.

One side effect of practicing this reversible operation may involve memory for strings of phonemes. There is a considerable body of research suggesting a relationship between verbal short term memory, phonological awareness, and reading. See Brady (1986) for a review. Work by Dreyer (1988) suggests that memory for strings of phonemes is a factor in blending ability. In the present study, the dramatic group differences in blending the longer words on the ITPA support the possibility that some aspect of phoneme segmentation practice helped experimental subjects develop a better memory for strings of phonemes. Controls' comments, such as "I can't do that. It's too many sounds!" and errors, such as "bee" for bables and "opst" for opasto are consistent with the notion that memory is a factor here.

One shortcoming of the present study is that while we are sure the trained superior readers were also superior blenders, we cannot be sure of a causal relationship with blending preceding reading. All we know is that segmentation

training seems to have facilitated both blending and reading. Our results are not consistent with those of Perfetti, Beck, Bell, and Hughes (1987) who suggest that blending is a simple precursor to reading. However, their blending task was easier than the ITPA which we used at posttest here. Their blending task involved words with two to four phonemes, while the ITPA includes words with up to seven phonemes. While both groups in the present study entered first grade with adequate blending skills, there is evidence that these skills continued to grow and that this growth was associated with reading, possibly in a reciprocal relationship. Ehri (1987) makes a strong case for the influence of print on both phonological skills and on speech. Remember that segmentation training here involved selecting lettered blocks and typing letters on a computer in response to spoken language. The use of letters may be the powerful piece here.

Print-rich whole language classrooms may also be a factor here. The availability of print during the training period cannot be ignored. The invented spelling used by all subjects for story writing in the classroom is quite similar in terms of task demands to the experimental training. This additional time on task and the direct experimental instruction may have encouraged trained subjects to connect spelling and reading strategies. This possible interaction is also difficult to tease apart.

The results do clarify our initial question, however. Where we were unsure of whether or not cvc words were being blended, or whether they were being read by an analogy strategy, there is now strong evidence that trained subjects had the capacity to use a sophisticated blend strategy. It is logical to think of blending being used in the initial encounter with a new letter combination, and that later on a combination could be recognized as a unit and

read through analogy with a known word. Anecdotal records suggest reliance on both strategies. Both blending and unit analogy strategies were observed in both groups over the course of the study, often by the same child at the same point in time. Interestingly, several low reading controls who were able to blend short words early in the study stopped using this strategy later on, while all experimental subjects were observing blending aloud at the final time of testing.

In conclusion, while blending appears to be a precursor to decoding, higher levels of blending are also associated with higher levels of decoding. Techniques using manipulative materials for segmentation training can facilitate blending. There may be a positive interaction between whole language reading instruction and short periods of explicit segmentation training using lettered blocks. This training complements whole language teaching by making speech-print relationships explicit.

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Table 1

Means and SD's on Descriptive Pretest Measures.

	Group				t
	Experimental		Control		
	M	SD	M	SD	
Slosson	120.5	15.47	125.9	15.51	0.82
Age in mos.	78.0	4.50	77.3	4.82	0.11
GORT	1.7	3.17	1.8	4.85	0.06
Word Attack	2.5	3.30	5.0	6.15	1.19

Note. In all cases n = 11.

Table 2

Training Sequence

	Experimental Group	Control Group
Early October	Pretests	
Mid October (8 weeks)	Letter-sound associations Segmenting and spelling cvc words (10 min.) Computer spelling games (10 min.)	Letter-sound associations Reading and blending cvc words (10 min.) Computer reading games (10 min.)
Mid December (8 weeks)	Letter-sound associations Segmenting and spelling cvc words ccvc/cvcc words (8 min.) Computer spelling games (12 min.)	Letter-sound associations Reading and blending cvc words ccvc/cvcc words (8 min.) Computer reading games (12 min.)
Late February (8 weeks)	Letter-sound associations Segmenting and spelling cvc words ccvc/cvcc words silent *e* digraph *ea* (5 min.) Computer spelling games (15 min.)	Letter-sound associations Reading and blending cvc words ccvc/cvcc words silent *e* digraph *ea* (5 min.) Computer reading games (15 min.)
Mid May	Posttests	

Table 3

Means and SD's by Treatment and Time on Pre- and Posttest Measures

	Time			
	Pretest		Posttest	
	M	SD	M	SD
Rosner				
Experimental	4.7	2.45	11.5	1.44
Control	4.5	2.62	8.4	3.07
Block Segmentation				
Experimental			20.2	4.64
Control			13.3	7.13
Roswell-Chall				
Experimental	18.5	8.61	29.6	0.67
Control	21.5	7.45	28.6	1.12
ITPA Blending				
Experimental			29.0	1.41
Control			24.7	2.41

Note. In all cases n = 11.

Appendix

Block Segmentation Test (Uhry)

Directions for Demonstration Item

"Repeat the word after I say it. Pig.
Now take a block as you say each sound in the word.
Like this. Pig. /p/ - /i/ - /g/."
(Examiner pushes a block into place from left to right for each sound.)

Directions for Practice Items

"Now you try it. Listen carefully. Cat. Say cat.
Now take a block as you say each sound in cat."
(Examiner models the task if the child cannot do it until the child is successful.)

Directions for Administering the Test

"Listen carefully.
Say each word first and then use the blocks and the pieces.
Ready?"
(Say each word and be sure the child repeats it. If there is not a match between the phonemes the child says and the blocks pushed into place, give the child a second chance to say a sound for each block. Credit if this second trial is correct. This can involve the child adjusting the number of blocks.)

Test Items

1. hot	10. content	18. zep
2. up	11. swept	19. vot
3. sip	12. brand	20. dopt
4. flag	13. splint	21. flict
5. risk	14. Eskimo	22. lobsad
6. picnic	15. scrap	23. struct
7. stilt	16. trumpet	24. plistat
8. print	17. fantastic	25. stramrod
9. clump		